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IS 9123 (1979): Specification for Battery Locomotives for use in Mines [MED 8: Mining Techniques and Equipment]

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IS : 9123 - 1979

(Reaffirmed 2005)

Indian Standard

SPECIFICATION FOR BATTERY LOCOMOTIVES FOR USE IN MINES

Mining Sectional Committee, EDC 50; Mine Locomotives Subcommittee, EDC 50 : 9 [Ref: Doc : EDC 50 (2797)]

1. Scope — Covers requirements for battery locomotives having double axle drive and ventilated type battery box for use in mines and other industrial areas.

1.1 This standard also covers the battery locomotives with flameproof characteristics (*see* **5.1**, **7.9.1**, **7.9.1.1**, **7.9.8.1** and **12.3**) for use in underground coal mines and other hazardous industrial areas with restricted applications.

2. Terminology

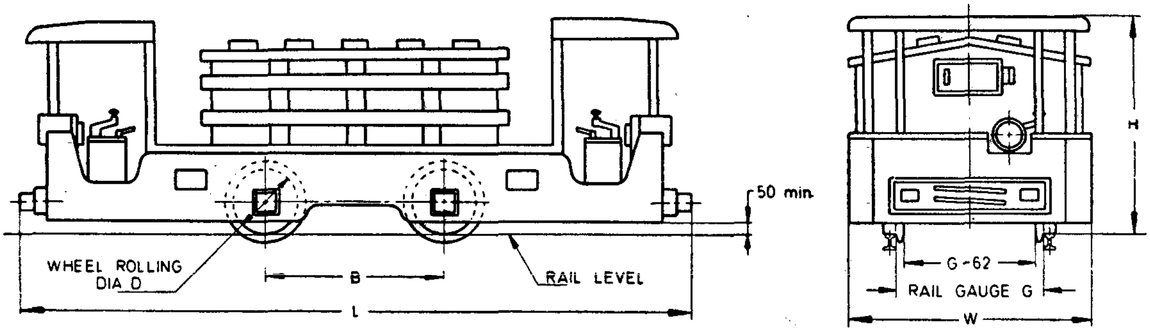
2.1 *Static (Adhesive) Weight* — The static weight of locomotive on powered axles.

3. *Types* — As specified in Table 1.

TABLE 1 TYPES OF BATTERY LOCOMOTIVES

Type		Nominal Static Weight Tonnes	Rail Gauge 'G' mm
Non-Flameproof Locomotive	Flameproof Locomotive		
LB3	LBF3	2·5	600
LB5	LBF5	4·5	600
LB5	LBF5	4·5	(762)
LB5	LBF5	4·5	900
LB8	LBF8	8	600
LB8	LBF8	8	(762)
LB8	LBF8	8	900
LB8	LBF8	8	1 000
LB8	LBF8	8	(1 067)
LB13	LBF13	13	900
LB13	LBF13	13	1 000
LB13	LBF13	13	(1 067)

4. Dimensions, Ratings and Main Parameters — As given in Table 2 read with Fig. 1.



All dimensions in millimetres.

FIG. 1 TYPICAL BATTERY LOCOMOTIVE WITH BOTH END CONTROL

5. Material

5.1 In case of battery locomotives with flameproof characteristics, every locomotive and each of its accessories shall, as far as practicable, be constructed of non-flammable material. Any inflammable material included therein, shall be shrouded with a substantial metallic covering to render it non-flammable.

Adopted 26 March 1979 | © December 1979, ISI | [redacted] Gr 5

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NEW DELHI 110002

5.2 Components of the main parts shall be manufactured from the material as mentioned against each in Table 3 or its equivalent.

TABLE 2 DIMENSIONS, RATINGS AND MAIN PARAMETERS OF BATTERY LOCOMOTIVES

(*Clauses* 4, 7.8.1, 7.9.2, *and* 7.9.3.2, and *Fig.* 1)

Type			LB3 or LBF3	LB5 or LBF5	LB8 or LBF8	LB13 or LBF13
Static Weight, kg			$2\,500^{+20\%}_{-0}$	$4\,500^{+20\%}_{-0}$	$8\,000^{+15\%}_{-0}$	$1\,300^{+10\%}_{-0}$
Rating	DC traction motor	Total installed power at hourly rating *Min*, kW	3	5	10	15
		No. of motors	1 or 2	2	2	2
		Nominal voltage, V	48	72 or 80	110 or 120	160
	Maximum speed, km/h		12	12	12	12
	Maximum tractive effort, kg ($\mu = 0{\cdot}25$)		$625^{+20\%}_{-0}$	$1\,125^{+20\%}_{-0}$	$2\,000^{+15\%}_{-0}$	$3\,250^{+10\%}_{-0}$
Battery	Type		Lead Acid			
	Capacity in ampere-hours at 5 hour rate discharge		300	400	600	600
Controlling equipment	Type		Direct or thyristor type			
	Notch number	Drum controller or contactor type of controller	3	8	8	8
		Thyristor type	Stepless			
Dimensions	Length over buffer, *L Max*, mm		1 895	3 600	4 750	5 600
	Total width, *W Max*, mm		G + 450	G + 500	G + 450	G + 450
	Height over rail, *H Max*, mm		1 300	1 650	1 650	1 650
	Wheel base, *B*, mm		600	950	1 200	1 500
	Wheel diameter (rolling), *D*, mm		380	450 or 540	680	680
	Minimum negotiable radius of curvature, mm		3 500	7 000	9 000	1 000
	Minimum clearance (worn out wheel) over rail, mm		50	50	50	50
Rail size	Weight of rail per metre, kg		Not less than 14	Not less than 14	Not less than 20	Not less than 23
Battery box	Type		Ventilated	Ventilated	Ventilated	Ventilated
Braking system			Mechanical and regenerative or rheostatic (optional)	Mechanical and regenerative or rheostatic (optional)	Mechanical and pneumatic (optional) and regenerative or rheostatic (optional)	Mechanical and pneumatic and regenerative or rheostatic (optional)
Sanding system			Mechanical	Mechanical	Mechanical	Mechanical or pneumatic

TABLE 3 MATERIALS FOR MAIN COMPONENTS OF THE LOCOMOTIVES

(*Clause* 5.2)

Components	Material Conforming to
1) a) Frame, battery box and battery box covers	IS : 226-1975 'Structural steel (standard quality) (*fifth revision*)'
b) Frame, if cast	IS : 1030-1974 'Carbon steel castings for general engineering purposes (*second revision*)'
2) *Drive*	
a) Axle, shaft and pins	Fe 570-HT (St 58-HT) of IS : 961-1975 'Structural steel (high tensile) (*second revision*)' or Class 4 of IS : 1875-1971 'Carbon steel billets, blooms, slabs and bars for forgings (*third revision*)' or C-45 or 40Cr1Mo28 of IS : 1570-1961 'Schedules for wrought steels for general engineering purposes'
b) Pinion shafts and gears	40Cr1, 40Cr1Mo60, 13Ni3Cr80 and 15NiCr1Mo12 of IS : 1570-1961
c) Worm gears	Phosphor Bronze
d) Wheel tyre	Grade 3A or 3B of IS : 2708-1973 '1·5 percent manganese steel castings (*first revision*)' or 40Cr1 of IS : 1570-1961
e) Wheel centres	Grade 25 of IS : 210-1970 'Grey iron castings (*second revision*)' or Grade 30-57 of IS : 1030-1974 or Class 3A or 4 of IS : 1875-1971
f) Cast wheel	Grade 2 of IS : 2707-1973 'Carbon steel castings for surface hardening (*first revision*)'
g) Axle box housing, gear box housing and covers of gear box housing	IS : 1030-1974 or IS : 226-1975
3) *Braking system*	
a) Brake spindle and hinge pins	Class 3A or 4 of IS : 1875-1971 or C45 of IS : 1570-1961
b) Levers, hanger, etc	IS : 226-1975
c) Hand wheel	IS : 1030-1974 or Grade 20 of IS : 210-1970
d) Brake shoe (without liner)	Grade 15 of IS : 210-1970
e) Brake shoe (with liner)	
i) Shoe	Grade 30-57 of IS : 1030-1974
ii) Liner	Grade 15 of IS : 210-1970
4) *Sanding system*	
a) Levers, tie rods, sand container	Fe410-S(St 42-S) of IS : 226-1975
b) Hinge pins	Medium carbon steel
5) Buffers, bracket, spring housing	Grade 30-57 of IS : 1030-1974 or Fe410-S(St42-S) of IS : 226-1975
6) Buffer's springs, frame suspension's springs	Steel conforming to IS : 3195-1965 'Steel for the manufacture of volute and helical springs (for railway rolling stock)' or 55 Si12Mn90 of IS : 1570-1961 or IS : 3885 (Part II)-1969 'Steel for the manufacture of laminated springs (railway rolling stock) : Part II Rib and groove sections

6. Designation — A battery locomotive of type LB5 for use on a rail gauge of 600 mm shall be designated as:

Battery Locomotive 1 LB5 IS : 9123

Note — The numbers 1, 2, 3, 4 and 5 shall be used to designate the rail gauge of 600 (762), 900, 1 000 and (1 067) mm respectively, prior to type in the designation of locomotive.

7. General Requirements

7.1 *Frame*

7.1.1 The frame shall be a rigid, robust, and of welded and/or bolted construction. Cast steel frames of weldable quality may also be used.

7.1.2 The locomotives up to 8 tonnes nominal static weight, shall be provided with rollers having bearings for easy manual handling of the battery box in charging station.

7.1.3 Suitable locking device shall be provided on the frame to prevent movement of battery box.

7.2 *Draw Gear and Buffer*

7.2.1 The spring loaded buffers and draw gears shall be provided for all type of locomotives. For locomotives with nominal static weight up to 4·5 tonnes, rubber pads may be used between buffer and frame for absorbing shocks.

7.2.2 Provision for locking against inadvertant disconnection of coupling shall be provided in the locomotive.

7.2.3 The type of coupling and its height from rail level shall be as agreed between purchaser and manufacturer considering the height of the mine cars to be hauled.

7.3 *Frame Suspension*

7.3.1 The main frame of the locomotive shall be supported on the axles by springs which may either be of coil type or of leaf type.

7.3.1.1 Rubber springs may also be used in place of coil or leaf spring.

7.3.2 Suitable shock absorber may be provided between frame and the axle box.

7.4 *Brake*

7.4.1 Every locomotive shall be provided with mechanical brake having self-locking arrangement.

7.4.2 Locomotives of 13 tonnes nominal static weight shall have a pneumatic brake in addition to mechanical brake.

7.4.2.1 If required by purchaser, locomotive of 8 tonnes nominal static weight also may be provided with pneumatic brake.

7.4.3 For the locomotive with pneumatic brake, capacity of compressor shall be less than 16 m^3/h to limit the energy consumption of electric motor.

7.4.3.1 Pressure of compressed air in the air receiver shall be 6 to 8 bar and working pressure of braking system, sanding system and signal system shall be 4 to 5 bar.

7.4.4 Braking system of all types of locomotive shall be provided with a suitable arrangement for adjusting clearance between brake shoe and wheel tread.

7.4.5 In case of thyristor type of controller (*see* **7.9.3.1**), the locomotives may be provided with regenerative or rheostatic braking system in addition to mechanical and pneumatic brake.

7.5 *Sanding System* — Sander shall have a sand box of suitable capacity which can be operated easily from drivers' seat. Sanding arrangement shall be such as to be effective both for forward and backward movement.

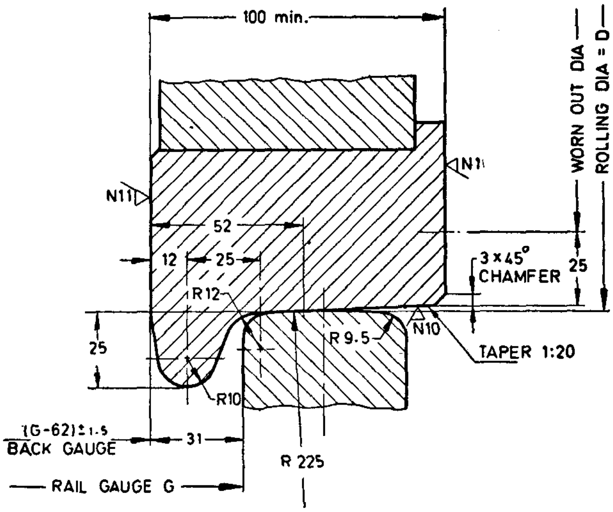
7.6 *Drive*

7.6.1 All gears shall be heat treated to give required mechanical properties and shall be run in a lubricating oil chamber.

7.6.2 *Wheels*

7.6.2.1 Locomotives shall have either solid cast steel wheel with integral wheel tyre or steel tyre wheel with cast steel centre except in case of locomotives of 2·5 tonne nominal static weight where wheel shall be of solid cast steel with integral wheel tyre. Wheel tyre shall be press/shrink fitted on to the wheel centre.

7.6.2.2 Distance between backgauge contour of the flange and tread of wheels shall have dimensions as laid down in Fig. 2.



All dimensions in millimetres.

FIG. 2 DIMENSIONS OF WHEEL CONTOUR

7.6.3 *Axle box*

7.6.3.1 Axle box shall be designed to contain sufficient quantity of lubricant and shall be dust proof.

7.6.3.2 Bearings of the axle boxes shall be of antifriction type. Bearings shall conform to relevant Indian Standards.

7.6.3.3 Axle box shall be so designed that it can allow free vertical movement of horn guides which are fixed to the frame by rivetting, welding, bolting, or by fitted bolts.

7.7 *Drive Suspension*

7.7.1 The suspension of motor of locomotives to the frame shall be as agreed between purchaser and manufacturer.

7.7.2 Either bush bearing made of brass or bronze or antifriction bearings shall be used for supporting the motor housing or gear box housing on the axle.

7.8 *Construction of Battery Box and Arrangement of Cells*

7.8.1 Lead acid cells conforming to IS : 5154-1969 'Lead-acid traction batteries' shall be assembled in steel tray. A number of such trays shall be assembled in the battery box. Ampere-hour capacity of cells in the battery box shall be as given in Table 2.

7.8.2 Steel tray shall be lined with anticorrosive and electrically insulated material and shall be sufficiently strong.

7.8.3 Number of cells in a steel tray shall not exceed 24.

7.8.4 Height of steel tray shall project beyond the cell body.

7.8.5 Suitable drain holes shall be provided at the bottom of the steel tray.

7.8.6 Battery boxes shall be of ventilated type so as to allow for the rapid dissipation of gases generated during discharging and for the release of heat. There shall be provision for entrance of fresh air at the bottom of the battery box and exit at the top of box to permit air circulation. A typical design of battery box is shown in Fig. 3.

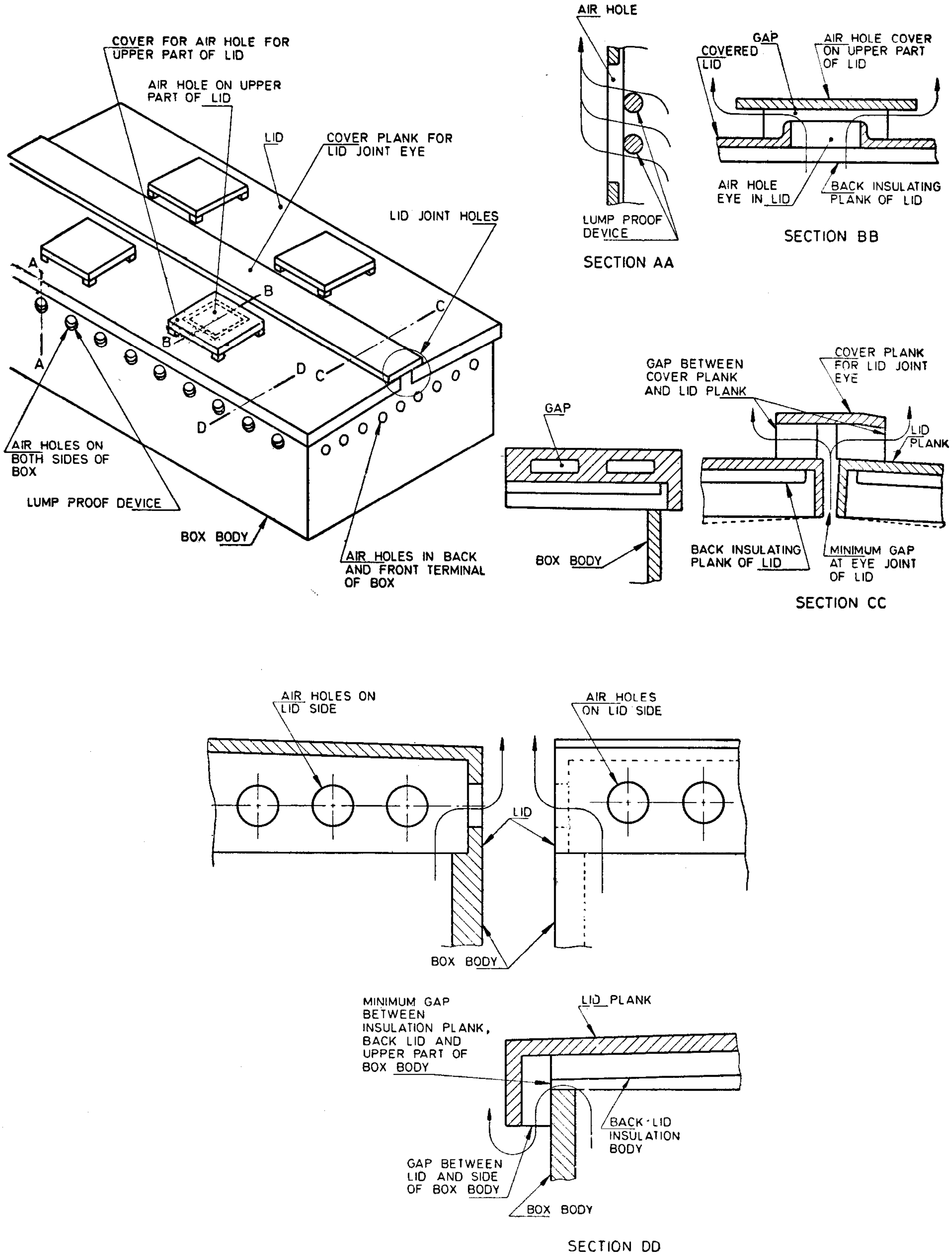

COVER FOR AIR HOLE FOR UPPER PART OF LID
AIR HOLE ON UPPER PART OF LID
LID
COVER PLANK FOR LID JOINT EYE
LID JOINT HOLES
A
A
B
B
C
C
D
D
AIR HOLES ON BOTH SIDES OF BOX
LUMP PROOF DEVICE
BOX BODY
AIR HOLES IN BACK AND FRONT TERMINAL OF BOX
AIR HOLE
LUMP PROOF DEVICE
SECTION AA
COVERED LID
GAP
AIR HOLE COVER ON UPPER PART OF LID
AIR HOLE EYE IN LID
BACK INSULATING PLANK OF LID
SECTION BB
GAP
BOX BODY
GAP BETWEEN COVER PLANK AND LID PLANK
COVER PLANK FOR LID JOINT EYE
LID PLANK
BACK INSULATING PLANK OF LID
MINIMUM GAP AT EYE JOINT OF LID
SECTION CC
AIR HOLES ON LID SIDE
AIR HOLES ON LID SIDE
LID
BOX BODY
MINIMUM GAP BETWEEN INSULATION PLANK, BACK LID AND UPPER PART OF BOX BODY
LID PLANK
BACK-LID INSULATION BODY
GAP BETWEEN LID AND SIDE OF BOX BODY
BOX BODY
SECTION DD

FIG. 3 TYPICAL DESIGN OF BATTERY BOX

7.8.7 It shall be manufactured by welding or rivetting and shall be coated with anticorrosive paint.

7.8.8 Ventilation openings in the side of the box for exit of gas shall be as close to the top of the battery box as the design permits.

7.8.9 Drainage and ventilation holes in the bottom of battery box shall be arranged as to safeguard any component underneath. If required, additional ventilation holes may be provided at the sides.

7.8.10 The ventilation of the battery box shall be such as to ensure that the concentration of hydrogen does not exceed one percent.

7.8.10.1 The total open area of vents for ventilation shall be not less than 0·55 sq m per cubic metre of hydrogen emitted by the battery per hour which is calculated from the following formula:

$$\text{Hydrogen emitted} = \text{No. of cells} \times \text{Ampere-Hour Capacity} \times 5 \times 10^{-6}\ \text{m}^3/\text{h}.$$

7.8.11 The covers of the battery box shall be made inclined towards the side so as to be convenient for dissipation of hydrogen gas during discharge and inside of the covers shall be anti-corrosive to electrolyte. The gap between the battery box cover and highest point of the cells shall be not less than 25 mm.

7.8.12 Suitable locking arrangement shall be provided for battery box covers, so that cover can not be opened by unauthorised persons.

7.8.13 Electrical insulation and cushioning material shall be placed between steel tray and battery box.

7.8.14 Cables for internal wiring of the locomotive shall conform to IS : 1554 (Part I)-1964 'PVC insulated (heavy duty) electric cables: Part I For working voltages up to and including 1 100 volts (*revised*)' or IS : 694 (Part I)-1964 'PVC insulated cables (for voltages up to 1 100 V): Part I With copper conductors (*revised*)'.

7.9 *Electrical Equipments*

7.9.1 For battery locomotives with flameproof characteristics, enclosures of all electrical equipments, for example, motor, controller, resistance boxes, circuit breaker unit, light, etc, except battery covers shall conform to the requirements of IS : 2148-1968 'Flameproof enclosures of electrical apparatus'.

7.9.1.1 In case of locomotives with flameproof characteristics, electrical meters, such as voltmeter, ammeter, speedometer, etc, shall be placed in an explosion proof voltage resistant cell. The compasses of metres shall be clearly visible from outside. The cell shall conform to requirements of IS : 2148-1968.

7.9.2 Main parameters of the traction motor shall conform to Table 2. The design of dc traction motors may be of special shape to suit the design of locomotives.

7.9.3 *Controller*

7.9.3.1 The battery locomotive shall be provided with either direct manually operated controller or thyristor type controller.

7.9.3.2 In case of direct controller, the design of the controller shall be such that for the purpose of accelerating and reversing the locomotives, the switching of main current is done entirely within the controller housing either by manually rotated drums on which segments carrying current are mounted or by manually rotated cams which actuate contactors carrying the current. Accelerating and reversing drums or cams shall be provided usually on separate interlocked shafts so that the accelerating shaft cannot rotate unless the reversing shaft is in either the 'forward' or, 'reverse' position and the reversing shaft cannot be rotated unless the accelerating shaft is in the 'off' position. Numbers of notch of controller shall be as specified in Table 2.

7.9.4 *Resistance boxes*—Resistances in the resistance boxes if used, shall be designed for smooth starting and controlling the traction motors of the locomotives for parallel and series operation.

7.9.5 *Circuit breaker unit*

7.9.5.1 It shall consist of a circuit breaker, one ampere-hour meter and a 2-pin plug and socket. Interlocking shall be provided to ensure that the plug can be removed only after disconnecting the supply from the battery. A voltmeter and an ammeter may be used in place of ampere-hour meter.

7.9.5.2 The circuit breaker shall be provided with a suitable overload and a short-circuit protection.

7.9.5.3 Ampere-hour meter if used, shall be designed to indicate the amount of charging and discharging of the battery.

7.9.6 *Head light* — Each locomotive shall be provided with two head lights, one at each end. The head light shall be capable of showing any obstacle in the road ahead within 60 m of the locomotive.

7.9.7 *Tail light* — Each locomotive shall be provided with two tail lights one at each end.

7.9.8 A pressure regulated switch shall be provided for automatic engagement and disengagement of the compressor motor depending on the compressed air pressure in the reservoir.

7.9.8.1 This switch shall be placed in a flameproof enclosure in case of locomotives with flameproof characteristics.

7.10 *Accessories*

7.10.1 Suitable provision shall be made in the locomotive to fix a portable lamp.

7.10.2 An adequately suitable warning bell shall be provided on the locomotives. The locomotives with pneumatic brake shall be provided with an additional pneumatic horn easily accessible to the driver while operating the locomotive in either direction.

7.10.3 A portable fire extinguisher conforming to IS : 2171-1972 'Portable fire extinguishers, dry powder type (*first revision*)' shall be provided in each of the driver's cabin.

7.10.4 The locomotive shall be provided with driver's seat in the cabin of the locomotive in such a way that the driver can see ahead without any discomfort.

7.10.5 A suitable canopy shall be provided on the cabin of the locomotive. Height of the cabin shall be not less than 1·2 m.

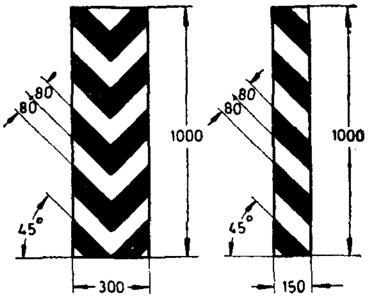
7.10.6 Red reflectors shall be provided on each end of the locomotive.

7.10.7 Each locomotive shall be provided with a detachable red lamp which shall be attached to the rear end of the locomotive or last mine car in a train of mine cars.

8. Painting/Coating

8.1 Suitable painting/coating as agreed between the manufacturer and the purchaser shall be applied on the locomotive.

8.2 Illuminous paint shall be applied at a conspicuous area on both ends, front and rear, of the locomotive preferably in a recessed portion in addition to the reflector. For guidance the design of painting is indicated in Fig. 4.



TYPE A TYPE B

All dimensions in millimetres.

FIG. 4 DESIGN OF PAINTING ON ENDS OF LOCOMOTIVE

9. Control

9.1 Double end control may be provided on the locomotive of 13 tonnes nominal static weight.

9.1.1 Good visibility in either driving direction shall be assured in locomotives with double end control.

9.2 The locomotives with double end control shall be provided with two drum controller, one at each end, and connected electrically. Control for braking, sanding and signal systems shall also be provided at each end. A suitable device shall be provided to operate the circuit breaker from both ends of the locomotives.

9.2.1 Arrangement shall be made in locomotives to isolate the control stand which is not in use.

10. Heat Treatment — Heat treatment of each component shall depend on material, shape and size of the components. Heat treatment of components of couplings and draw gear shall be done to obtain a factor of safety of seven with respect to maximum tractive effort of locomotive.

11. Marking — Battery box of the locomotive shall be marked with the following information on a name-plate:

a) Type and numbers of cells, and
b) Nominal voltage of battery.

11.1 Each locomotive shall be marked with the following informations on a name-plate placed at a suitable place in the locomotive.

a) Type and Sl No. of the locomotive,
b) Manufacturing date and identification number,
c) Static weight in kg,
d) Tractive effort at hourly rating in kg,
e) Maximum speed of the locomotive at hourly rating in km/h, and
f) Name of the manufacturer and identification mark.

11.2 *ISI Certification Marking* — Details available with the Indian Standards Institution.

12. Tests

12.1 *Bench Test of Drive* — After complete assembly of drive, the locomotive shall be run for 45 minutes in each direction for checking of abnormality or sound, heating of gear box oil and bearings, axle box bearings and teeth contact.

12.2 *Running Test of Locomotive* — After passing the bench test, each locomotive shall be run for 30 minutes in both directions in the plant by the manufacturer and performance results shall be endorsed on the certificate of test and examination of the locomotive (*see* Appendix A). Insulation resistance of the electrical circuit, performance of breaking, sanding, signalling and effectiveness of lubrication shall be checked.

12.3 *Flameproof Test* — For locomotives with flameproof characteristics, flameproof enclosure of each electrical component except battery box that is motor, drum controller, resistance boxes, circuit breaker unit, head light, etc, shall be tested in accordance with the requirements of IS : 2148-1968.

12.4 *Ventilation Test of Battery Box* — Effectiveness of ventilation of battery box shall be tested to ensure the proper ventilation of the battery box.

APPENDIX A

(*Clause* 12.2)

PRO FORMA FOR THE CERTIFICATE OF TEST AND EXAMINATION OF LOCOMOTIVE

1. Locomotive type
2. Serial number
3. Date of manufacture and identification mark
4. Mass of locomotive:
    a) Mass of locomotive without battery box in kg
    b) Mass of locomotive with battery box in kg
5. Number of traction motors and serial numbers
6. a) Power of each traction motor, kW
    b) Nominal voltage, volts

7. a) Storage battery type, make and voltage
   b) Capacity
8. Speed of locomotive on load at nominal voltage (design), km/h
9. Tractive effort, hourly rating (design), kg
10. Dimensions

	Actual Measured Value in mm
Length over buffer	
Total height; overall	
Wheel base	
Wheel diameter	
Minimum clearance above rail	
Back gauge (track gauge)	
Negotiable radius of curvature *Min*, m	

11. Performance test
    a) Braking system
    b) Sanding system
    c) Alarm signals
    d) Lighting
12. Insulation resistance of control circuit
13. a) Result of running test of the locomotive
    b) Result of bench test of drive
14. a) Total running time of locomotive in each direction
    b) Total running time of drive in each direction
15. Conformity of electrical equipments to IS : 2148-1968 in case of locomotives with flameproof characteristics

We hereby certify that the locomotive described above complies in all respect with IS : 9123-1979 and that it has been subjected to the test mentioned and subsequently examined by a competent person.

EXPLANATORY NOTE

While preparing this standard, considerable assistance has been derived from the following publications:

DIN 23337-1974 'Warnstreifen fur Grubenlokomotives (Safety signs for mining locomotives)' issued by DIN Deutsches Institut für Normung

JIS M 6512-1966 'Explosion proof type battery locomotives' issued by Japanese Industrial Standards Committee

Publication No. MI 1-1965 'Mining industrial electrical locomotive' issued by National Electrical Manufacturers' Association, USA.

Printed at New India Printing Press, Khurja, India